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ABSTRACT

Using the Ohio Technology Transfer Organization (OTTO) as its primary example, this paper offers a strategic planning perspective on technology transfer and human resources development. First, a brief overview is provided of the maturation of mission priorities and planning processes in higher education in the United States, followed by a definition of technology transfer as a means to facilitate economic development, increase productivity, and stimulate job growth. Next, several components of OTTO (a statewide network of postsecondary institutions providing small business and industry with the information, advice, and services essential to technology transfer) are described, along with other state and national efforts in the field. A strategic plan to accomplish technology transfer and human resources development is then presented within the framework of three components: (1) research and development; (2) delivery systems; and (3) evaluation. The research and development component is examined in terms of futurism, trend analysis, high technologies, modes of technology transfer, technology assessment, entrepreneurship, and community development. The delivery systems component is considered with reference to personnel and alternative forms of the electronic delivery of education and training. The process of evaluation is presented in terms of costs, capital planning, and management of the planning process. In a brief conclusion, the future of postsecondary education is linked to the degree to which it meets social needs. (HB)

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STRATEGIC PLANNING OF TECHNOLOGY TRANSFER

by

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presented at the

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Ohio Academy of Science

April 23, 1982

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ABSTRACT

Technology transfer is a means to facilitate economic development, increase productivity, and stimulate job growth. What is needed to accomplish technology transfer are models which efficiently and effectively reduce the lag between production of R & D and its application. Major producers of R & D include the more than 200 Federal R & D laboratories and centers representing 11 agencies in the Federal Laboratory Consortium.

The Ohio Board of Regents obtained funding for the Ohio Technology Transfer Organization beginning with the 1979-1981 biennium. This state-wide network consisting of The Ohio State University and two-year institutions working with state and federal agencies is intended to provide small business and industry access to information, advice, and services essential to economic development and job growth. In addition, the Division of Vocational Education of the Ohio Department of Education initiated a program to link Ohio's extensive public vocational-technical education system to regional and state-level economic development. Local Vocational/Technical Resource Consortia were initiated during 1980 in 23 regions throughout the state. At the state level the program is coordinated with the Ohio Department of Economic and Community Development, the Ohio Chamber of Commerce, the State Labor Council and other business and labor groups.

This paper will present the brokering model and discuss its economic implications from a strategic planning perspective.

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MUTUALITY OF INTERESTS

> There was a time when many institutions of higher education were regarded as enclaves within their surrounding communities. Although the walls around campuses were less formidable than those of prisons, they symbolized a purposeful separation of the worlds of formal learning and ordinary living. Town-and gown relationships were frequently characterized by hostility on the one side and aloofness on the other. With the growth of higher education's importance to society, this relationship in most places, fortunately, has undergone a marked change. Unfortunately, however, the mutuality of interests is still not widely understood and as fully appreciated as it ought to be.[1]

* * * * * * * * * * * * * * * * *

Shortly after I began to work on my presentation, I was reminded of the minister who had been reassigned to a parish in Texas. Because he wanted to impress the congregation, he pulled his best sermon from his files. Only one parishioner, a cowboy, appeared in church on Sunday. The minister preached the entire sermon. After church the minister asked the cowboy how he liked the sermon. The cowboy responded, "You know Reverend, each night I take a load of fodder down to the watering hole to feed the cattle. If only one cow shows up, however, I don't give her the whole load."

After spending some time on the presentation, and not wanting to give you the entire load, I settled on the following limited, but achieveable objectives:

1. To explain briefly the maturation of mission priorities and planning processes in higher education in this nation,
2. To define technology transfer in a context which requires some way for dealing with environmental scanning and trend analysis,
3. To describe several components of the present system for technology transfer and training delivery, and
4. To discuss a strategic plan to accomplish technology transfer and human resource development.

The Maturation of Mission Priorities and Planning Processes

During the post World War II years mission priorities had a focus on acquiring resources and facilities for the increased number of students resulting from the equal right demand for access to postsecondary education and limited research to support selected purposes of the industrial society. Planning in postsecondary education during the 1960s was undertaken in response to immediate needs of the instruction and research mission priorities with minimum regard to the long-term future.

During the 1970s the influx of traditional 18 to 22 year old students began to stabilize. In addition, research and development underwent significant change. Reports by the Organization for Economic Cooperation and Development,[2] the National Commission on Research,[3] and the National Science Board[4] trace the shift toward "socially relevant research", the democratization of university decision making and the accompanying "bureaueratization of university research", the rapid deterioration and growing obsolescence of laboratory equipment, and the aging of research faculty and lower morale of junior faculty. Additionally, business and industry had to shift to defensive R & D with 2 to 3 year payoffs, leaving much of the large scale "industrialized" basic research to the government.

Postsecondary education began to experience the impact of a broad range of demographic, social, economic, and political forces. As a result, organizations such as The Council of Independent Colleges (formerly The Council for the Advancement of Small Colleges), the Academy for Educational Development, and the American Association of State Colleges and Universities launched programs relating to comprehensive institutional planning. These projects, and others like them, all stressed the need to assess the external environment. The literature began to reflect descriptions of institutional planning processes including some way to assess the external environment.[5]

During this period of time, phenomenal growth occurred for a broad range of education and training providers including business and industry, the

department of defense, professional associations, adult education associations, and proprietary organizations. The National Conference Board, for example, indicated that in the single recession year of 1975 this nation's 7,500 largest private employers spent over $2 billion on employee education or as much as the recent annual totals of all contributions from all sources to colleges and universities. In 1979, an article in The New York Times stated, "The American Telephone and Telegraph company spent $700 million on educational programs for its employees, or more than three times the $213 million annual budget of the Massachusetts Institute of Technology."[7] An article in the May 1980 issue of the Training and Development Journal stated, "Industry spends on employee education more than six times the amount appropriated by all the states for all of higher education."[8] In 1981, an article in The New York Times stated "Within a short drive of Boston, a city with no shortage of higher education, are four new degree-granting programs that are not even affiliated with a college or university. They are sponsored by a hospital, a bank, a consulting firm, and a computer manufacturer."[9]

The slowdown in productivity caused state-level planners to reexamine the role of education in economic revitalization. Thus, the intrusion of a broader range of education and training providers and a significant change in the research partnership resulted in a focus on a public service mission priority.

Technology Transfer Defined

Any discussion about technology transfer must begin with a definition of technology. Bugliarello offers a biosocial view of technology. He states:

> Technology is a process, it is a social process which generates and combines know-how and people in order to extend the physical range of man. The range, if you like, and power over muscles, over the brain, and over organs. Thus, technology is a people process; it's done by people and it enhances people.

> But it is also a biological process, because in enhancing people, it continues to be carried on outside of our bodies. And by now, really, to a growing extent, with pacemakers and artificial organs, also inside our bodies. It continues to carry out the process of evolution. Both as a people process and as a biological process, technology has been with us from the very beginning of our species some two million years ago. Thus, technology was born with people, technology has been developed by people and technology has affected people.[10]

Young says, "Technology is all the techniques, knowledge, lore, methods and tools that have helped society survive and improve its life."[11] Branscomb states, "Many people tend to think of technology as being embodied in the machines that we invent and use, but technology is certainly not machines. Technology is what people do with what they know."[12]

Several persons make a distinction between science and technology. Kahn indicates that science can be thought of as "rules" and technology as "tools" with science as the pursuit of knowledge while technology is the use of knowledge. "The scientist may pursue knowledge for its own sake but the technologist is utility-oriented."[13] Richman states:

> Technology is not merely the application of science. The wheel and the lever owe nothing to theoretical physics and the bow and the arrow were used without knowledge of ballistics. Man knew the "how" before he learned the "why." Increasingly, however, science is preceding technology. By better understanding the rules, we can anticipate ways of putting them to use. Theory sometimes paves the way for practice today. In turn, technology provides the devices scientists need in their pursuit of knowledge.[14]

Pascarella states, "Both science and technology are the fruits of creativity. Developing an invention or bringing an innovation into the marketplace demands a blending of knowledge, insights, and anticipation of need."[15]

Two other terms are important to any discussion about technology transfer, infrastructure and appropriate technology. Burke states:

> Change occurs as a result of many factors, but only under certain conditions. The most important is that a "technological infrastrucrure" must exist. The Egyptians could not have invented the plow if they had not known how to work with wood or domesticate animals. Second, for the technolo-

> gical change to take hold, be used, and have an effect, there must be a need for it. Pots were not made before there was a surplus of something that people wanted to keep.[16]

The term appropriate technology has become acknowledged as "a complete package solution to the development problems of a particular community rather than a piecemeal list of particular solutions. This package is appropriate to the local skills and other resources and offers the prospect of continuous development in the future."[17]

Thus, technology transfer is the process of disseminating techniques, knowledge, lore, methods, and tools which are appropriate to a variety of marketplace needs.

A Description of Several Components of the Current Technology Transfer System

Ohio is a highly-industrialized state that is a national leader in fabricated metals, rubber, plastics, stone, clay and non-electrical machinery. The state, however, faces important economic challenges that include obsolescence in manufacturing facilities, decline in productivity, and below average growth in high technology and service industries. In order to meet these challenges and to provide a climate for business and industry which is supportive and conducive to expansion, the Ohio Board of Regents proposed and the Ohio Legislature funded the Ohio Technology Transfer Organization beginning with the 1979-1981 biennium. This state-wide network consisting of The Ohio State University and two-year institutions working with state and federal agencies is intended to provide small business and industry access to information, advice, and services that are essential to economic development and job growth.

To accomplish this purpose, a full-time technology transfer agent is located on each of thirteen two-year college campuses (11 in the 1979-1981 biennium) and The Ohio State University. The primary function of the OTTO agent is to assume an active role providing technological assistance to constituents within a geographic region of the state. (See FIGURE 1) The OTTO agent, whose services

FIGURE 1

OTTO DISTRICTS
1982 - 83
LAKE ERIE
WILLIAMS
FULTON
LUCAS
HENRY
DEFIANCE
PAULDING
PUTNAM
VAN WERT
ALLEN
HARDIN
WYANDOT
CRAWFORD
RICHLAND
ASHLAND
WAYNE
STARK
MAHONING
COLUMBIANA
TRUMBULL
PORTAGE
MEDINA
ERIE
HURON
LORAIN
CUYAHOGA
MERCER
AUGLAIZE
SHELBY
LOGAN
UNION
DELAWARE
MARION
MORROW
KNOX
HOLMES
CARROLL
HARRISON
JEFFERSON
DARKE
MIAMI
CHAMPAIGN
CLARK
MADISON
FRANKLIN
PREBLE
MONTGOMERY
GREENE
FAYETTE
PICKAWAY
PERRY
MUSKINGUM
GUERNSEY
BELMONT
NOBLE
MONROE
MORGAN
WASHINGTON
FAIRFIELD
HOCKING
BUTLER
WARREN
CLINTON
ROSS
VINTON
ATHENS
MEIGS
HAMILTON
CLERMONT
HIGHLAND
PIKE
JACKSON
GALLIA
BROWN
ADAMS
SCIOTO
LAWRENCE
OHIO RIVER
OTTO AGENTS
FUTURE OTTO DISTRICTS

are free, acts as a user broker in providing direct access to member colleges and OSU or to alternative sources of assistance. Typical cases might include obtaining information about plastics, corrosion, resource recovery, solar energy, or management assistance in areas such as inventory control, business record keeping, and general management. OTTO agents have access to computerized data bases which can be searched for recently published articles on almost any topic. Information sources include the National Technical Information Service and the more than 200 Federal R & D laboratories and centers representing 11 Federal agencies in the Federal Laboratory Consortium. (See FIGURE 2). The 1981 Annual Report of OTTO provides a detailed analysis of the organization's progress.

Because of the relationship between technology transfer and training, another effort which deserves mention is the Ohio Vocational/Technical Resource Consortia.* In early 1980 the Division of Vocational Education of the Ohio Department of Education initiated a program to link Ohio's extensive public vocational-technical education system to regional and state-level economic development. Local consortia were initiated during 1980 in 23 regions throughout the state. (See FIGURE 3) At the state level the program is coordinated with the Ohio Department of Economic and Community Development, the Ohio Chamber of Commerce, the State Labor Council and other business and labor groups. (* Now called the Ohio Job Training Consortia)

The principle activities of the operating consortia are: (1) to determine present and future numbers of job openings in various occupations for each consortia service area; (2) to determine training needs for new and existing jobs; (3) to determine the match between training needs and training resources and facilities; and (4) to act as communication forums for all training needs and resources of business, industry, labor, government and education.

FIGURE 2

FEDERAL LABORATORY CONSORTIUM

FIGURE 3

OHIO VOCATIONAL - TECHNICAL CONSORTIUM DISTRICTS

Geographically, consortia are composed of 2 or more vocational education planning districts (Ohio is divided into 103 vocational education planning districts - VEPD) including all technical college and branch campus facilities within those districts.

A vocational-technical resource consortium consists of facilities and staff of all vocational-technical and university branch campuses. A consortium committee typically consists of a consortium director and 15-20 senior executives from the area business community, vocational and technical colleges and branch campuses, and organized labor. These consortia are governed by officers elected by the members of the committee and will operate under the sponsorship of the chamber of commerce or educational agencies. To assist the consoritum director, housing and staff necessary for the functioning of the consortium is supplied by the member educational institutions, local chambers of commerce, or other arrangements.

The consortia were initially organized using state and federal vocational education funds. Each region received $29,000 and is also supplemented by local contributions for clerical support, supplies, office space and utilities through chambers of commerce and education institutions. The state seeks annual appropriations from the state legislature to fund research and training programs operated through the consortia.

Another activity related to the technology transfer concept was the announcement in early 1981 that Sinclair Community College and Stark Technical College had been selected by the U.S. Small Business Administration (USSBA) to be among 100 community colleges in a national call for innovative, cost-effective strategies for reducing the high percentage of business failure. Colleges work with management assistance personnel in the 65 USSBA field offices to identify and deliver quality short-term training to meet the needs of local entrepreneurs. Special emphasis is given to the needs of women and minority small business firms.

A Strategic Plan To Accomplish Technology Transfer and Human Resource Development

All concepts pass through various stages of evolution or development from the "gist" of an idea to becoming an operational reality. The technology transfer and human resource development system uses the resources of Ohio colleges and universities and state and federal agencies to address specific problems encountered by Ohio's firms. This state assisted system is intended to reduce the lag between the development of new ideas and their dissemination through the normal course of events in the free enterprise system. This system, however, is in the early stages of evolution and has not benefitted from the intellectual rigor and scholarship it deserves and requires. The emphasis, thus far, has been on getting started with service delivery in a limited sort of way and stops short of any strategic approach.

Following a presentation at the Second National Conference on the Role of Community Colleges in the National Technology Transfer Program on October 19-21, 1981, this author sent his paper to the state coordinator of two-year colleges in the 50 states in an effort to obtain models of technology transfer.[18] Although numerous states have programs to encourage cooperation between postsecondary education and business and industry for training, no state reported a model for technology transfer. Of the 16 states responding to this inquiry, South Carolina's "Design for the 80's" was the most elaborate training model with centers in advanced machine tool design, robotics, computer applications, microelectronics, the office of the future, and environmental quality training.[19]

In the absence of other statewide technology transfer models to analyze critically and from which to borrow ideas, I shall attempt to broad stroke some thoughts in the hope that leaders in the state will seize upon parts of this conceptual framework and create a mechanism to develop it more fully. Ideally, it would be desirable to have a proactive model for economic

development where long range goals grow out of a state scenario of some fuzzy images of its long-term future. For example, the history of the development of human society can be traced from the hunting society through the agricultural society to the industrial society. In the hunting society, mankind was concerned primarily with extracting things from nature. The transformation to the agricultural society was slow and based on rather simple technological innovation. The hunting and agriculture societies can be characterized as interactions between people and nature. In comparison, the transformation from the agricultural society to the industrial society occurred more quickly and was the result of technological advances in energy, transportation, communications, raw materials, and research and development networks. The industrial society can be characterized as interactions between people and goods or fabricated nature. More recently, advances in the industrial society have been the result of the integration of macro technological systems, the aggregation of complex technological developments in each of the above mentioned networks.

During recent years we have experienced the onset of a transformation to a new type of society. Masuda indicates:

> Mankind is now entering a period of transformation from an industrial society to an information society.... Man is now standing at the threshold of a period of innovation in a new societal technology based on the combination of computer and communications technology. This is a completely new type of societal technology, quite unlike any of the past. Its substance is information, which is invisible. This new societal technology will bring about societal transformation which, in a double sense, is unprecendented.[20]

This transformation to the information society is concerned with the shift from physical productivity of material goods to information productivity and can be expected to bring about fundamental changes in human values, in trends of thought, and in the political and economic structures of society. This learning and information society will be characterized as interactions between people and ideas and knowledge.

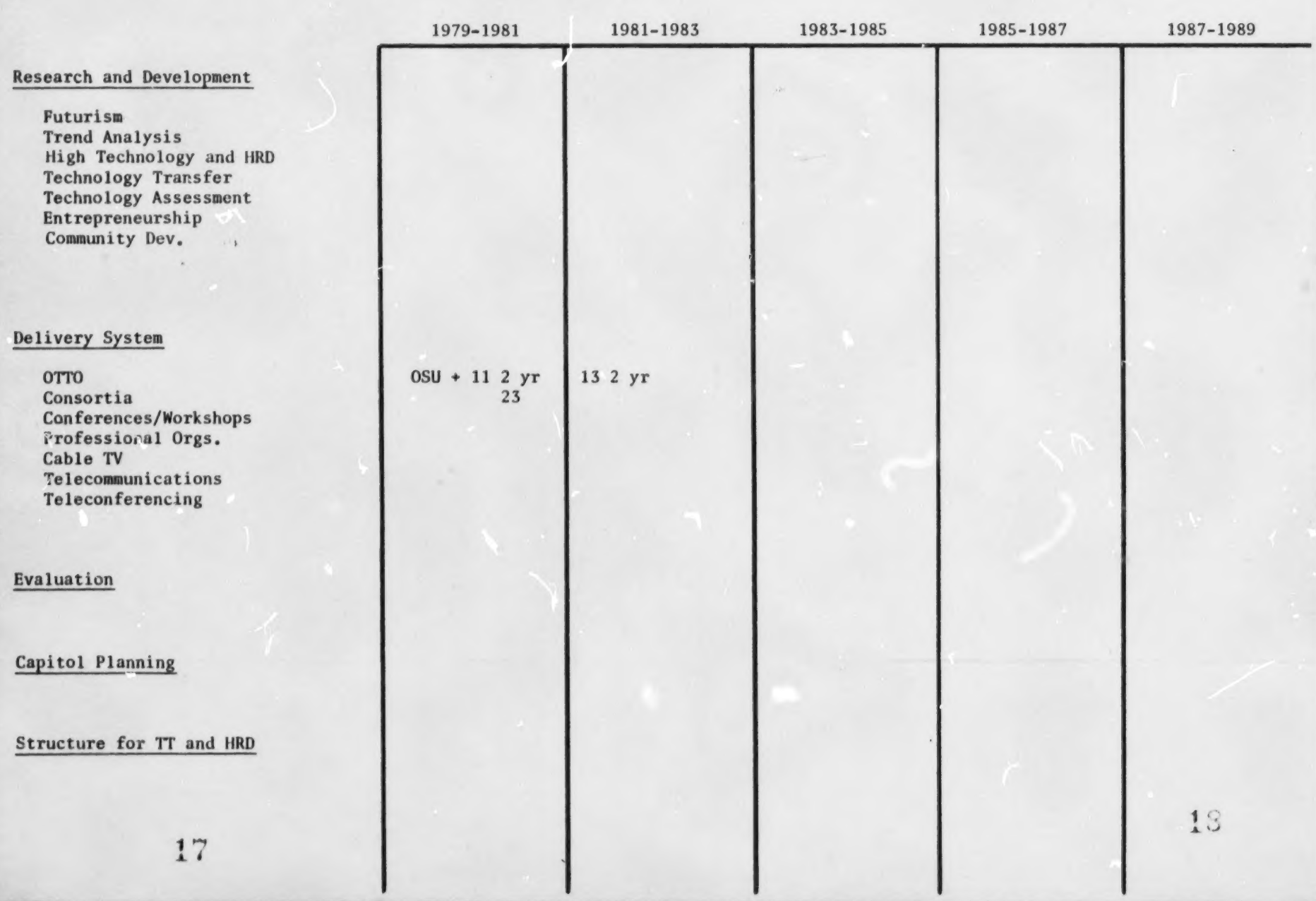
Mr. Masuda is one of the early pioneers of computerization in Japan. Beginning with Japan's first Computer White Paper in the mid-60's, he developed "The Plan for an Information Society: Japan's National Goal Toward the Year 2000." At a recent U.S. House Science, Research, and Technology Subcommittee hearing at the Center of Science and Industry in Columbus, ID Systems President John Heibel told the congressional panel, "Ten years ago Japan set the development of consumer electronics as a national priority. Five years ago Japan set as a national priority the refinement of the automobile. A year ago they set as a new priority the development of artificial intelligence and computer peripherals. Japan is now a leader in each of these areas."[21] Does Ohio have a proactive planning model for generating a state scenario about its long-term future from which economic development goals can be derived and to which purposeful human activity can be linked? We all know the answer to that question.

In the absence of such a capability, let us pursue a model of lesser sophistication. For purposes of discussion let us approach the development of a strategic plan for technology transfer and human resource development into three aggregate categories (1) research and development, (2) delivery system, and (3) evaluation. Research and development in this listing will be comprised of (1) futurism, (2) trend analysis, (3) high technology R & D, (4) technology transfer, (5) technology assessment, (6) entrepreneurship, and (7) community development. (See FIGURE 4)

Futurism. Although Ohio may not have a long-term scenario, there are numerous persons and groups who have given more than casual thought to the future of Ohio. Chapters of the World Future Society exist in Akron, Cincinnati, Cleveland, Columbus, Springfield, and Toledo. A mechanism can be developed to specify regional scenarios using the talents of WFS members and other interested persons. Regional scenarios can be aggregated into a statewide scenario from which long term goals can be developed.

FIGURE 4

A STRATEGIC PLAN FOR TECHNOLOGY TRANSFER AND HUMAN RESOURCE DEVELOPMENT



Trend Analysis. Trend analysis consists of the systematic review of comparable data over time in order to determine direction. In 1967, the Institute of Life Insurance conducted a Future Outlook Study to assess significant social and political trends because it seemed clear that reactive styles were not appropriate in times of rapid change. One result of the Future Outlook Study was a call for an ongoing mechanism to be established by which the business could keep abreast of emerging ideas and social changes that might affect its operating environment. In 1970, an early-warning system called the Trend Analysis Program (TAP) was designed and put into place. TAP continues to operate as a program of the American Council of Life Insurance, formed in 1976 by a merger of the Institute of Life Insurance and the American Life Insurance Association. TAP is useful as a model in that the screening function is carried out by over one hundred life insurance executives who monitor almost one hundred periodicals.[22]

Trend analysis data could be gathered for every major industry. Data are already being gathered by industry, by a variety of organizations such as the Society of Manufacturing Engineers and the National Tooling and Machining Association, the U.S. Department of Commerce,[23] and the Work in American Institute, Inc., a nonprofit organization founded in 1975 to advance productivity and the quality of working life. The Institute's Studies in Productivity include reports on Mid-Career Perspectives: The Middle-Aged and Older Population; Productivity and the Quality of Working Life; Trends in Product Quality and Worker Attitude; Managerial Productivity; Worker Alienation; Human Patterns of Work; New Patterns of Work; Occupational Stress and Productivity; Redesigning Work: A Strategy for Change; Jobs and the Environment; and Changing Attitudes Toward Work.[24]

The trend analysis function must strive to produce meaning in relating historical data to alternative scenarios, to formulate assumptions to guide the state's decision-making process. The transformation from a highly-

industrialized state to whatever it is to become should be a coordinated process if the state is interested in avoiding major dislocations to its institutions and people.

High Technology and HRD. Major changes are occuring in American society and business and industry. The development of a post-industrial society and the phenomenal growth of high technology industries will require educational programs and services that are often beyond the current scope and mission of institutions serving a particular geographic region. While businesses and industries press institutions for new programs that will meet their needs and the needs of their employees, legislators and tax payers currently are not appropriating sufficient funds to maintain existing educational programs. At a time when there is need to establish computer and scientific literacy as a state-wide goal, this state's institutions, educational and business and industry, are trying to cope with the 20 percent of adults who are functionally illiterate and another 30 percent who are at a marginal level. Indeed, illiteracy has become a growing worry and menace on the job as more companies are finding that their employees lack basic reading, writing, and listening skills necessary for their work.[25]

Paralleling the challenge of specifying strategic goals relating to high technology of the post-industrial, information society is the need to develop an infrastructure relative to human resource development. In an issue of Education Update, the AFL-CIO indicated that "One of the most pressing problems in labor education is to determine educational needs of union members."[26] At the first Business-Higher Education Forum conducted by the American Council on Education it was concluded that "Universities and colleges lack sensitivity to the product and manpower needs of industry and business."[27] The National Center for Higher Education Management Systems, through its Direct Assistance Program, has recently completed a report on "Assessing the Educational Needs of High Technology Industries Served by SUNY - Binghamton." Both the specific

content and the process could be of value in our context.

Technology Transfer. Very little is known about the relationship between research and development, new product development and organizational development. All concepts and ideas pass through various stages of evolution or development. This holds true for R & D, new product development, and organizational development including management technology. R & D passes through stages which could be labeled problem formulation, research, development, demonstration and dissemination. New products pass through stages could be labeled the "gist of an idea, prototype model, full-scale production, marketing, and maintaining. Kotler states:

> A company typically has to develop a great number of new product ideas in order to finish with a few good ones. Booz, Allen & Hamilton study this question for fifty-one companies and summarized its findings in the form of a decay curve of new-product ideas. Of every fifty-eight-odd ideas, about 12 pass the initial screening test, which shows them to be compatible with company objectives and resources. Of these, some seven remain after a thorough evaluation of their profit potential. About three survive the product-development stage, two survive the test-marketing stage, and only one is commercially successful. Thus, about fifty-eight new ideas must be generated to find the good one.[28]

Thus, in any type of industry there must be an organizational climate and infrastructure appropriate to nurture the creativity and ideas from conceptualization to full maturity.

With regard to organizational development, one widely utilized view of the developmental sequence represents evolution progressing from small to integrated to diversified. A number of writers have suggested stages beyond the three-stage model. Steinmetz proposes a four-stage model consisting of direct supervision, supervised supervisor, indirect control, and divisional organization.[29] His labels deal with methods of control, thus he focuses directly on the need for changes in style at various stages of development. Breiner describes five stages each with its own management style to achieve growth (1) creativity, (2) direction, (3) delegation, (4) coordination,

and (5) collaboration.[30] Between each stage a particular crisis is posited, thus requiring a style change. These crises involve first leadership, then autonomy, then control, and finally a participative style of mutual goal setting through a matrix of teams. James has a somewhat different concept of the organizational life cycle by focusing more on the problems faced at each phase of evolution; his five stages include (1) emergence, (2) growth (3) maturity, (4) regeneration, and (5) decline.[31] The concept of stages of corporate development for computer/data processing activities has been described by Nolan as (1) initiation, (2) contagion, (3) control, (4) integration, (5) data administration, and (6) maturity.[32]

It is becoming increasingly clear that the strategies an organization uses are influenced by its position in a developmental sequence. All of the models emphasize the style and strategy changes associated with growth and the problems associated with these changes. Organizations at different stages of evolution tend to elicit different managerial and organizational styles. This will often mean that those who led the organization at one stage may not be able to do so effectively at another. In the first stage an organization requires a single guiding executive who basically operates a "one-person show." Such executives tend to be rather authoritarian, to emphasize short term thinking, and to have an operating orientation. In the second stage a group of managers with functionally specialized responsibilities replaces the single authoritarian executive. Thus, the chief executive must be able to work with members of the management team and utilize their talents effectively. The move to other stages is accompanied by a divisionalized structure with loose control over the operating units while stressing long-term strategic planning.

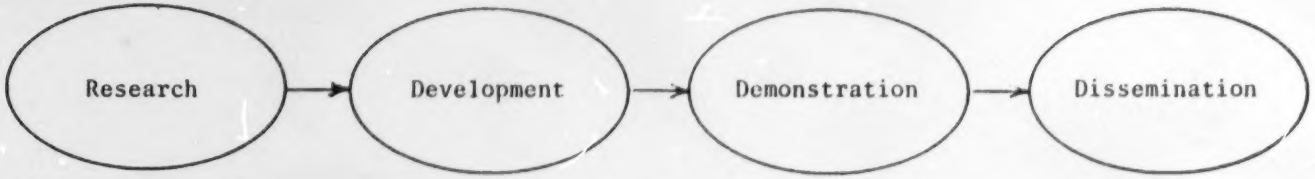
These continnua are displayed in FIGURE 5.

Technology Assessment. A growing number of major issues such as energy, environment, natural resources, agriculture, telecommunications, health, and

FIGURE 5

RESEARCH AND DEVELOPMENT CYCLE

Research and Development

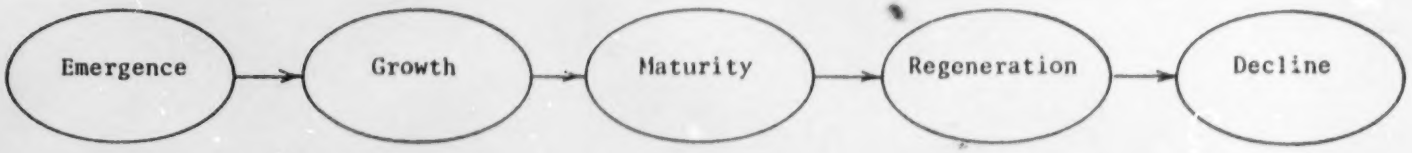


NEW PRODUCT DEVELOPMENT CYCLE

Product Development

STAGE OF ORGANIZATIONAL DEVELOPMENT

Organizational Development



transportation are complex, highly technical, involve long-range impacts, and contain social as well as economic factors. During the 1960's the United States Congress found that failure to consider the complexity, cost, breadth, and long-term implications of technology led to policy decisions that were sometimes inappropriate, ineffective, or worse. In deciding such issues, Congress often relied on inadequate, conflicting, and biased information from outside sources. In 1972, after a long series of studies and hearings, Congress authorized the establishment of the Office of Technology Assessment (OTA) as a congressional source of information and analysis that is nonpartisan, expert, objective, and anticipatory.[33]

A list of current assessment projects is displayed in FIGURE 6. The description of the assessment project on "Societal Impact of Telecommunications Technology" is as follows:

> This study reviews the telecommunication technology base and industry structure and identifies major participants in the domestic common carrier telecommunication sector, their roles and interactions. A variety of future policy frameworks are being developed, including one that assumes no major change in the extant legislative base. The implications of these alternative policy frameworks are examined on the basis of a common set of key issues, and the projected implications will be set forth as far and as clearly as possible. Common issues being examined include aspects of rates, economics, and accounting; implications of regulation; competition and industry oversight; industry and market structures; role of the Bell system; the use of resources and impacts on R & D; and implications for using and affected publics.

The strategic plan for technology transfer and human resource development should have some mechanism to benefit from research about technology assessment.

Entrepreneurship. Technology transfer is a means to facilitate economic development, increase productivity, and stimulate job growth. I have seen no document that provides a definition of these three areas of emphasis or charts a course of action for OTTO and the Vocational-Technical Consortia. In addition, OTTO and VTC are too young to have established a track record. A casual reading

FIGURE 6

ASSESSMENTS IN PROGRESS

ENERGY, MATERIALS, AND INTERNATIONAL SECURITY
Alternative Energy Futures
Solar Power Satellite Systems
Synthetic Fuels for Transportation
Dispersed Electric Energy Generation Systems
Nuclear Powerplant Standardization
Impact of Technology on Competitiveness of U.S. Electronics Industry
U.S. Industrial Competitiveness: A Comparison of Steel, Electronics, and Automobiles
Technology and Soviet Energy Availability
MX Missile Basing
Development and Production Potential of Federal Coal Leases
Nonnuclear Industrial Hazardous Waste

HEALTH AND LIFE SCIENCES
U.S. Food and Agricultural Research
Impact of Technology on Productivity of the Land
Technologies for Determining Cancer Risks From the Environment
Evaluation of Veterans Administration Agent Orange Protocol
Medical Technology and the Handicapped
Strategies for Medical Technology Assessment
Impacts of Applied Genetics
Technology and World Population

SCIENCE, INFORMATION, AND NATURAL RESOURCES
Technological Innovation and Health, Safety, and Environmental Regulations
Societal Impact of National Information Systems (NIS)
Societal Impact of Telecommunications Technology
Radio Frequency Use and Management Impacts From the World Administrative Radio Conference of 1979
The Patent System and New Technological Enterprises
Information Technology and Education
High-Level Radioactive Waste Management and Disposal
Freshwater Resources Management, Planning, and Policy: An Assessment of Models and Predictive Methods
Ocean Research Technology
Impact of Atmospheric Alterations
Space Policy and Applications
The Impact of Advanced Air Transport Technology
Airport and Air Traffic Control System

Current Assessment Activities (OTA), March 21, 1981, p. 4.

of the literature indicates that research can be gathered for three categories of variables: (1) person-centered, (2) product/technology centered, and (3) context-centered. Perhaps these three categories of variables can be paired with three dimensions of economic growth (1) job creation, (2) increased productivity, and (3) economic/profit stimulation to form a matrix for examining the research evidence. (See FIGURE 7)

Michael Barker, Director of Policy Studies for the Council of State Planning Agencies of the National Governors Conference, indicates that 80% of the new jobs are created by establishments with 20 or fewer employees and no more than 4 years of age.[35] This fits into cell A-3 in the matrix. Cooper and Dunkelberg found that most entrepreneurs started their companies when they were 25 to 40; many are highly educated with 36% having 16 or more years of schooling; and about 50% had entrepreneural parents.[36] This fits into row 1 of the matrix.

Assume for discussion purposes that the strategic planning process suggests that the greatest return on investment could be realized from concentrating on 4 types of small manufacturing establishments: (1) fabricated metal products, (2) machinery, (3) electric/electronic, and (4) instruments. In Ohio, their number by size was as listed below:

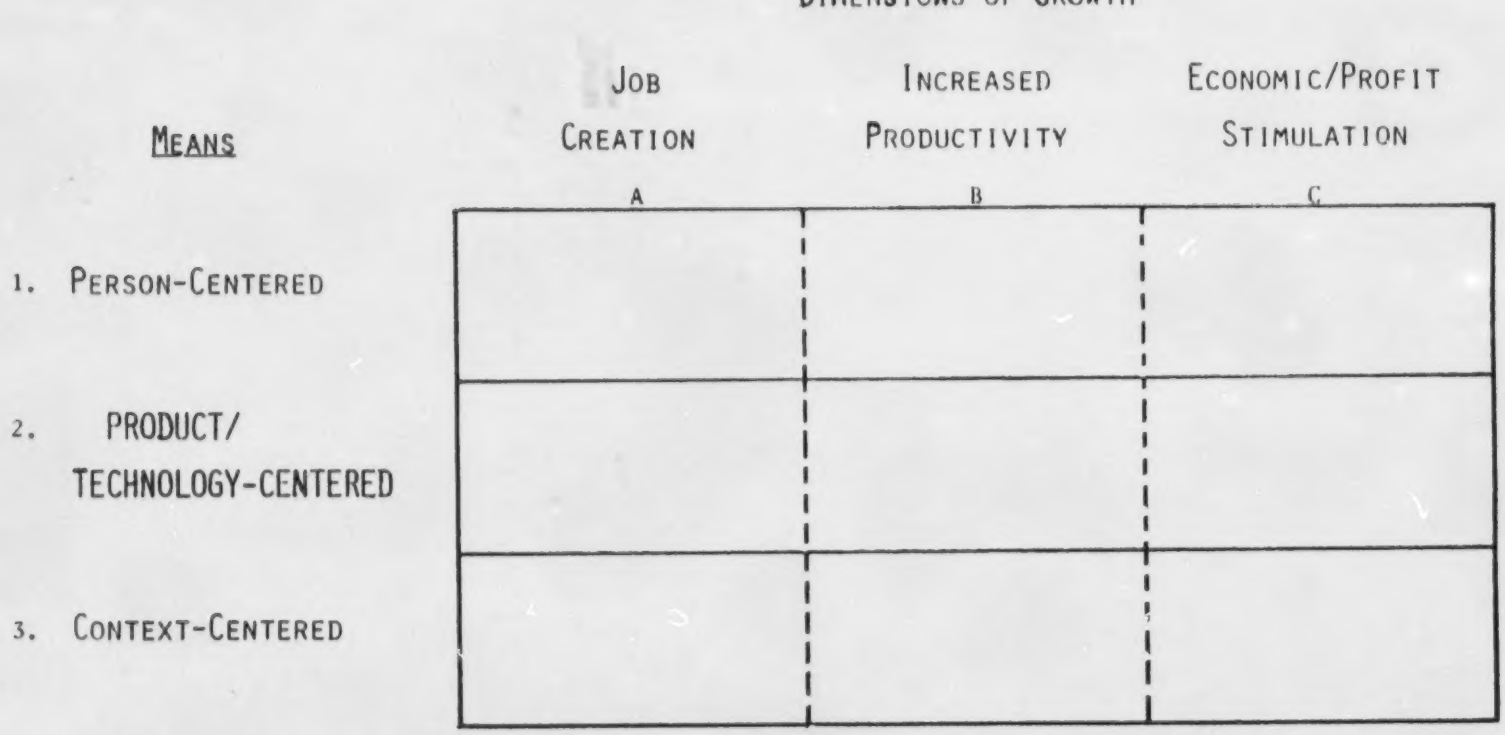
	Establishments By Employment Size*		
	1-4	5-9	10-18
Fabricated Metal Products	337	279	457
Machinery	887	683	683
Electric/Electronic	107	66	75
Instruments	66	45	50

* See FIGURE 8 for Ohio establishments by type and employment size.

Entrepreneurs could be identified and the resources of OTTO and VTC could be dedicated to assisting these establishments.

FIGURE 7

THE RELATIONSHIP OF "MEANS" TO ECONOMIC GROWTH



Community Development. During the late 1960's and the 1970's, a number of municipalities participated in a process to establish and implement communal or statewide goals. In an article in the March-April 1971 issue of City, Routh indicated that some 100 cities and three state governments had launched such an effort.[37] The first and largest of the major goals programs was that of Dallas, underway for nearly six years by 1971. This effort yielded a set of goals in areas of citizen involvement, continuing education, cultural activities, design of the city, economy, elementary and secondary education, energy, environment, government, health, higher education, housing, human service, public safety, quality of the citizenry, recreation and leisure time, and transportation. That process continues today. A 1978 gift from the Dallas Foundation to Goals for Dallas supported the publication Achieving the Goals for Dallas, 1978-1983.[38]

This type of strategic municipal planning is in the early stages of development and will undoubtedly continue in the 1980s. Municipalities interested in undertaking such a process can obtain a Community Planning Assistance Kit from the Council of Educational Facility Planners[39] and assistance from the International City Management Association including its book The Essential Community: Local Government in the Year 2000.[40] Community development should be a component of the strategic plan for technology transfer and human resource development. One municipality in our service area is hoping to fund a "Technical Assistant" to help new or existing small businesses through the Technical assisance program of the Community Development Block Grant Program.

The American Association of Community and Junior Colleges currently is in the first year of a three year grant from the W. W. Kellogg Foundation to establish a series of seminars and workshops in two-year colleges to assist citizen boards of community organizations. Such an effort could be launched for community organizations concerned with economic revitalization.[41]

FIGURE 8

EMPLOYEES AND ESTABLISHMENTS BY INDUSTRY, 1979

	Number of Employees	Number of Establishments	Number of Establishments By Employment Size								
			1-4	5-9	10-19	20-49	50-99	100-249	250-499	500-999	1000+
Agriculture, forestry, fisheries	9226	1939	1454	282	132	59	7	3	2	-	-
Mining	32192	1154	422	241	201	178	58	34	9	9	2
Contract construction	182005	19364	12012	3587	2036	1235	316	142	27	6	3
Manufacturing	1414824	15890	3519	2421	2804	3047	1628	1394	599	264	214
Chemicals	47950	653	134	89	121	132	71	61	29	12	4
Petroleum/coal	7161	168	55	30	29	25	15	8	1	5	-
Rubber/plastics	100479	852	135	76	105	201	139	122	46	13	15
Stone/glass	52421	977	207	172	195	194	91	78	19	15	6
Primary metals	148712	633	78	52	77	130	98	85	58	28	27
Fabricated metal products	178283	2248	337	279	457	526	289	237	76	24	23
Machinery	216119	3515	887	683	683	650	250	198	88	43	33
Electric/electronic	108036	811	107	66	75	100	79	84	45	30	25
Transportation equipment	176012	398	55	45	59	60	38	49	35	25	32
Instruments	24619	297	66	45	50	56	28	27	16	5	4
Transportation	200869	6577	2708	1127	1076	948	376	230	65	25	22
Wholesale Trade	279939	16563	6409	3953	3208	2205	546	191	35	13	3
Retail trade	751815	56520	25449	14289	8505	5699	1880	551	116	26	11
Finance, Ins, R. Estate	211125	18521	10899	3726	2154	1171	350	138	47	25	11
Services	768079	57306	33716	11728	6224	3487	1178	655	170	83	65
TOTAL	3833422	201238	103203	41908	26531	18067	6339	3338	1070	451	331

SOURCE: Ohio County Business Patterns 1979 (Washington, D. C.: Bureau of the Census, 1981) pp. 3-15.

Delivery System. Currently the delivery system for technology transfer and human resource development consists of 13 field based OTTO agents and 23 field based consortia agents plus central office support staff for both programs. Although some direction is being provided from both central offices, it is limited in scope and deals essentially with the nuts and bolts. Coordination within a region is a function, for the most part, of happenstance as opposed to a blueprint or grand design representing intelligent anticipation of a sequence of activities and events. Our consortia was the last to hire a director. This was attributable, mostly, to those of us who are concerned about such fundamental concepts such as mission, purpose, image, and expected outcomes, not to mention costs. Our OTTO region was one of the two funded in the second biennium of the project. As chairperson of the search and screen committee and the person to whom the OTTO agent reports, even though the agent covers the service areas of two technical colleges, I can assure you we took a scholarly approach to select our ambassador of technology transfer.

The point of this discussion is to emphasize the need to analyze critically alternative delivery systems for technology transfer and human resource development. The 36 field based agents are essentially "on their own" to make contacts with persons in establishments who could benefit from the services of these two mechanisms. This process could be judged on a continuum extending from "aimless meandering" to "directed contact." At this point in the development of the system I have not seen any document which gives an overview of the OTTO and VTC Advisory Committees, their composition and the approach taken by each of the 36 groups. I suspect we are all over the board.

At the first meeting of our OTTO Advisory Committee on January 21, 1982, it was suggested that our agent focus, as much as possible, on job creation. This decision was based on research reported in this paper. At its second meeting on March 11, the Advisory Committee reviewed person-centered and product-centered research.* As a result, it was decided to focus on transfer

of management intensive technology, as opposed to capital intensive technology, and to concentrate on (1) absenteeism (2) preventive maintenance, (3) subcontract analysis, and (4) cost analysis/pay back. If the system continues its present mode of operation, it should strive toward the "directed contact" end of the evaluation continuum based on some sort of rationale.

Alternative delivery systems, however, should not be restricted to being more efficient with the present format. The strategic plan for TT-HRD should include a series of well thought out, interrelated conferences and workshops based on direction and issues from the discussions on futurism, trend analysis, etc.[43] These issues are explicit in such works as Making America Work;[44] The Reindustrialization of America; Work in America;[45] Working in the Twenty-First Century;[46] Challenging Strategic Planning Assumptions;[47] Human Resource Planning;[48] and documents produced by the Committee on Economic Development,[49] the Robot Institute of America,[50] the "LTV looking Ahead" series,[51] The Conference Board,[52] and corporations such as Exxon[53] and Upjohn.[54] Workshops and conferences should be developed with a broad range of state and national organizations with state and local chapters. The list would include the Ohio Association for Staff, Program, and Organization Development; the Ohio Council for Inter-Institutional Research; the Human Resource Planning Society; and the American Society for Training and Development, an organization that recently launched a strategic planning process for its membership.

Alternative delivery systems should include a variety of modes of operation Just as Japan set selected strategic goals several years ago, so too must Ohio set selected strategic goals, one of which must be in the area of electronic

*Research by Robert Cooper indicates that the most important dimensions leading to new product success are (1) product uniqueness and superiority, (2) market knowledge and marketing proficiency, and (3) technical and production synergy and proficiency.[42]

delivery of education and training. Persons registering early for the World Future Society Fourth General Assembly "Communications and the Future" received the volume Communications Tomorrow: The Coming of the Information Society.[55] This anthology of selections from The Futurist along with Masuda's The Information Society As Post-Industrial Society are preludes to the Fourth General Assembly to be held in Washington July 18-22, 1982, and "must read" material for anyone concerned with the transmission of knowledge. Examples of the electronic delivery of education and training can be noted in two of the six projects funded in the first round of the Corporation for Public Broadcasting/Annenberg School of Communications instructional grants. Coast Community College, Dallas County Community College, Miami-Dade Community College, and the Southern California Consortium for Community College Television will produce college-level telecourses in English composition and in introduction to computers, both of which are scheduled for broadcast in 1984. Bergen Community College in New Jersey will be involved in a project to develop a science course with WNET-TV and W. H. Freeman, Co., publishers of Scientific American. All of the above-mentioned colleges are members of the AACJC Instructional Television Consortium. The American Association for Higher Education's Telescan lists 70 educational delivery systems throughout the United States that use telecommunications to serve postsecondary learners.

Evaluation. During recent years many Americans have become concerned about the return on investment in education. This year the TT/HRD system is costing the taxpayers something in the neighborhood of $1¼ M. If we are going to continue to make such an investment, we should accept the challenge to develop a strategic plan and them commit the intellectual and fiscal resources necessary to give it a reasonable chance to succeed based on specified outcomes in advance. This TT/HRD effort deserves the full-time services of someone to provide the leadership in developing a strategic plan modeled around some type of conceptual framework against which its success or failure can be evaluated.

Capital Planning. Am. Sub. H.B. No. 552 contains $627,023,311 for higher education. Shortly after the passage of H.B. 552 state agencies received a request to submit a FY 1983-84 Capital Budget and a FY 1983-88 Capital Plan. While these requests are supported by bonds, the debt service to retire the bonds comes directly off the top of the yearly operating budget. The percent of the operating budget going to debt service retirement has risen considerably in recent years, from 1.07 percent in 1970-71 to approximately 14 percent in 1980-81. It seems only logical that capital requests be reviewed to determine their relationship to economic revitalization goals. Should we be encumbering ourselves to debt service retirement over the next thirty years by investing in natatoria replacements, multi-purpose centers, and convocation halls or should all such capital requests be screened against a mosaic of economic and social goals?

Structure for TT and HRD. Currently each OTTO and VTC agent has an advisory committee comprised of institutional leadership and representatives from the service area. The two groups of agents meet monthly to discuss operations type issues and exchange ideas. The Presidents of two-year institutions serving as host sites for OTTO agents form a committee which has met infrequently. If the TT/HRD model is to move through the developmental sequence beyond the getting started phase, a structure must be developed to chart a course of action.

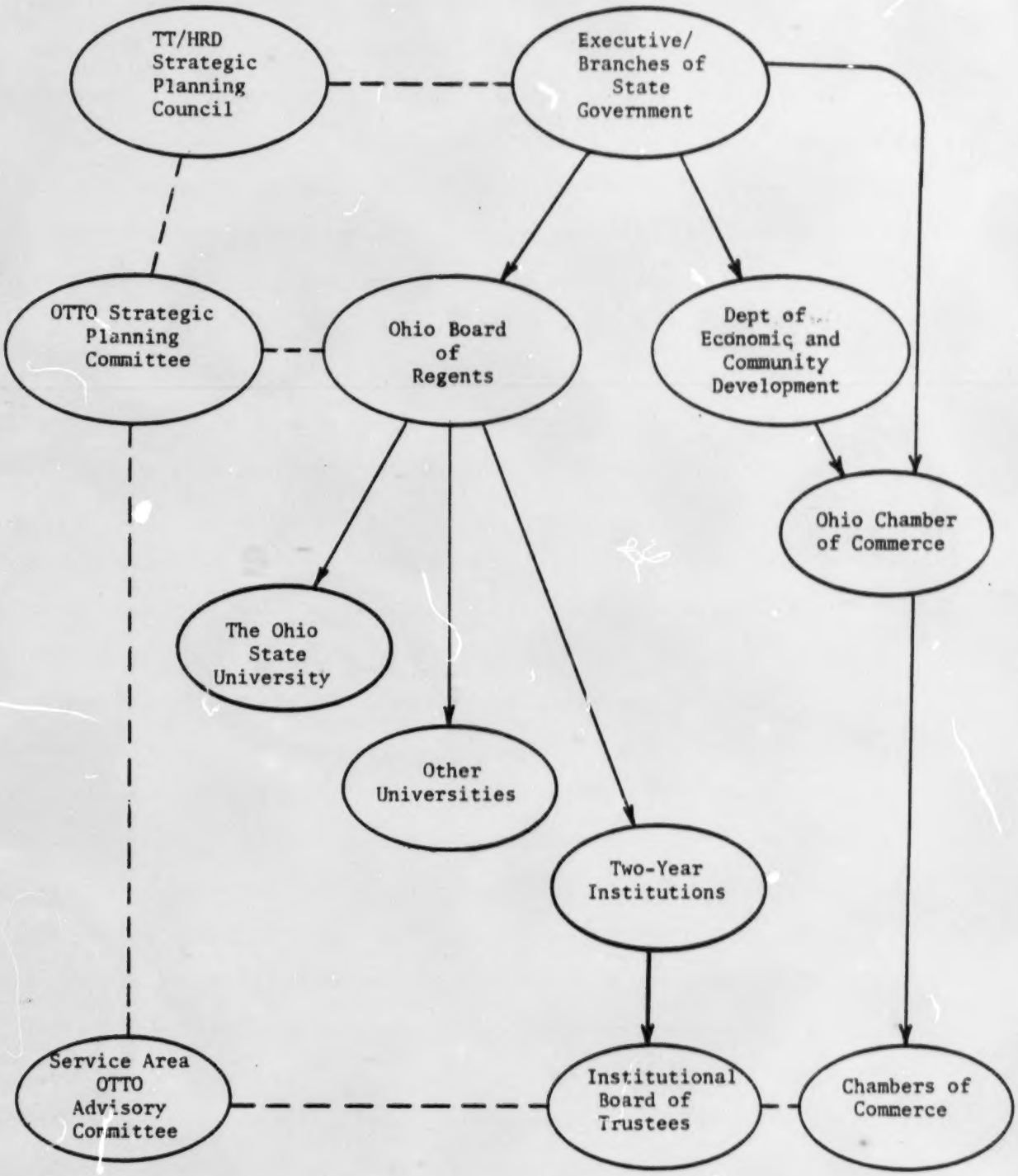
A state level TT/HRD Strategic Planning Council should be established to provide general direction to the effort. The TT/HRD SPC should be comprised of top level consumers and providers representing business and industry, the R & D community, government, and education. This group would critically analyze alternative future scenarios for Ohio and trend analysis data and recommend strategic economic revitalization goals to the executive branches of state government, including state-assisted post-secondary education. (See FIGURE 9)

I shall target comments at post-secondary education for reasons that will become apparent. The Ohio Citizen's Task Force on Higher Education in 1974 and

FIGURE 9

A PARTIAL STRUCTURE FOR THE STRATEGIC

PLANNING AND COORDINATION OF TECHNOLOGY TRANSFER/HUMAN RESOURCE DEVELOPMENT



the 1976 Ohio Board of Regents Master Plan identified paramount goals for Ohio's diverse structure of higher education and called for a shift from episodic, periodic production of master plans once every five years to a continuous, systemic mode of planning. Strategic planning, management, and evaluation is, essentially, a process of matching results of an external environment assessment with the results of an internal audit of an institution or system. The external environment consists of demographic trends, social expectations, economic trends, and governmental planning. The OBR recently went through its episodic spasm to produce a Master Plan which had a statutory completion date of 1981. This past February we were asked to comment on a draft of what is now labeled the 1982 Master Plan for Higher Education. The document is woefully inadequate in its analysis of the larger society of which higher education is a part, particularly social expectations, economic trends, and governmental planning. Without such data, how can the system develop a plan for "A New Social Compact"? If the document has a redeeming value, it lies in the fact that there is a "mutuality of interest" between higher education and economic revitalization in the state. But even then, the impetus grows out of the 114th Ohio General Assembly's mandate "to study and make recommendations regarding an Ohio business and industry extension service" as opposed to a proactive, strategic planning thrust by those of us who supposedly are providing leadership for the system.

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Another component of the structure must be an OTTO Strategic Planning Committee. Technology transfer/human resource development is a chicken and egg situation. One cannot transfer computer-oriented R & D or high technology until an infrastructure and knowledge base exists. The relationship between OTTO and VTC must be clarified. It is quite clear that OTTO, or some type of business and industry extension service mechanism, should play a major role in the economic revitalization of Ohio. The mechanism and its role, however, deserves the active participation of knowledgeable persons who are able and willing to dedicate time to provide some direction to it.

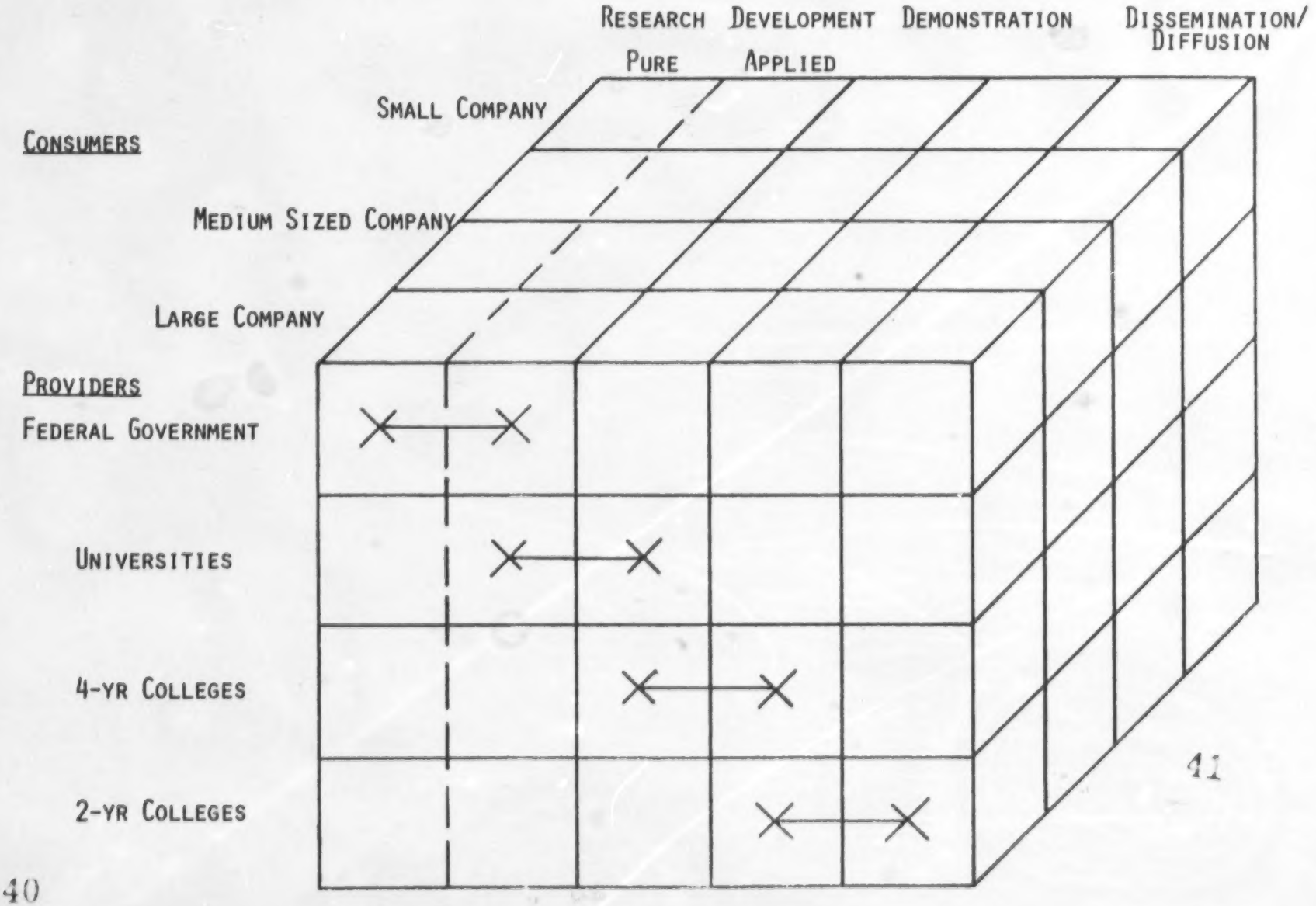
One additional point deserves some attention. This paper began with a brief description of the maturation of mission priorities and planning processes. Comments were made about changes in the research partnership and the focus on the public service mission. The draft 1982 Master Plan for Higher Education indicates Ohio's 12 universities spend $91 + M in separately budgeted research and $84 + M in public service activities in 1979-80.[57] These figures predate much of what is described in this paper. I can assure you that expenditures are considerable for public service activities by the 8 community colleges and 17 technical colleges. The paper also described the strategic planning concept. Numerous other states have a person at the Vice Chancellor level responsible for integrating academic, student services, fiscal, and capital planning. That process includes some way to assess the external environment and direct the resources of the higher education system toward selected goals. In addition to the need for a better strategic planning capability at the state level, there is an equally important need for a strategic planning capability within OBR. Only through such an effort can we hope to have a clearer delineation of the continuum extending from "pure" research through its application, the needs of a variety of types of consumers, and the unique role that different types of postsecondary education institutions can play in job creation, increasing productivity, or other dimensions of economic revitalization. These relationships are displayed in FIGURE 10.

Conclusion

The February 28, 1977, issue of The Chronicle of Higher Education contains an article entitled "Where Are the Leaders in Higher Education?" The author alleges that the modern collegial context has caused the disappearance of the statesman leader in preference to the institutional manager. Bowen indicates that colleges experienced enrollment declines in 1934, 1944, and 1952 and suggests four options: (1) redirect resources toward higher quality, (2) redirect resources toward research and public service, (3) redirect resources

FIGURE 10

RESEARCH AND DEVELOPMENT/DIFFUSION CONTINUUM



toward new student clientele, and (4) retrenchment.[58] Levine asserts that the "single-minded concern with surviving must give way to a commitment to thriving. The accent must shift from persisting to prospering."[59] Knight suggests the way to cope with the challenges of the 80's is through strategic planning, marketing and an entrepreneurial attitude.[60]

In conclusion, the future of postsecondary education rests on the degree to which it meets the needs of the society in which it exists. As society changes, so must postsecondary education change. The way in which a specific college or a statewide system meets the challenge of being responsive to societal needs is a function, for the most part, of its sophistication in planning. Whatever our course of action, a statement from Three Thousand Futures is most appropriate:

> The future holds many unknowns. It also holds a range of already known choices that can be made by those making decisions about higher education.... External, particularly market, pressures will not alone lead to the best results. Internal thought, resolution, and determination are needed to assure that higher education as a whole and institutions individually reach 2000 with capacity to perform undiminished or minimally diminished by the demographic depression. The surrounding environment in the next 20 years will create some special problems that we can already see. It does not, however, determine in advance how well these problems will be solved or how inadequately human choice, or absense of choice, will settle that. A downward drift in quality, balance, integrity, dynamism, diversity, private initiative, research capability is not only possible--it is quite likely. But it is not required by external events. It is a matter of choice and not just of fate. The emphasis should be on "managing of excellence."[61]

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